FIG. 1

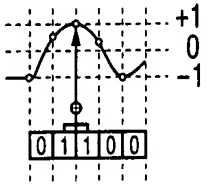
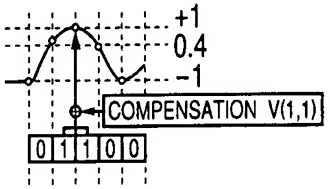
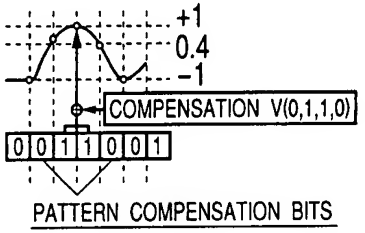
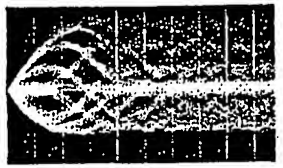
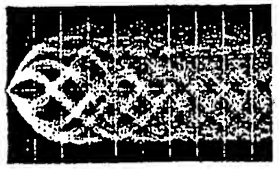
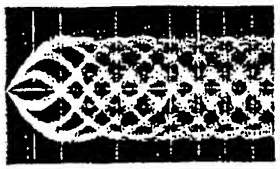
		METHOD-1	METHOD-2	NEW METHOD
MAIN FUNCTION		CONVENTIONAL (METHOD)	COMPENSATES ASYMMETRY	COMPENSATES NON-LINEAR SHIFTS
CONFIGURATION PR(1,1)				
NUMBER OF LEVELS		3	3	3
PATTERN COMPENSATION BITS		0	0	2(=1+1)
NUMBER OF COMPENSATION VALUES (V)		0	$4(=2^2)$	$16(=2^4)$
FUNCTION	ASYMMETRY	×	○	○
	INTER-SYMBOL INTERFERENCE	×	×	○
EXPERIMENTAL RESULTS Tw = 57nm 100Mbps		 BIT ERROR RATE = 50×10^{-4} 2T S/N = 3.6dB	 BIT ERROR RATE = 15×10^{-4} 2T S/N = 6.1dB	 BIT ERROR RATE < 0.05×10^{-4} 2T S/N = 9.5dB

FIG. 2A

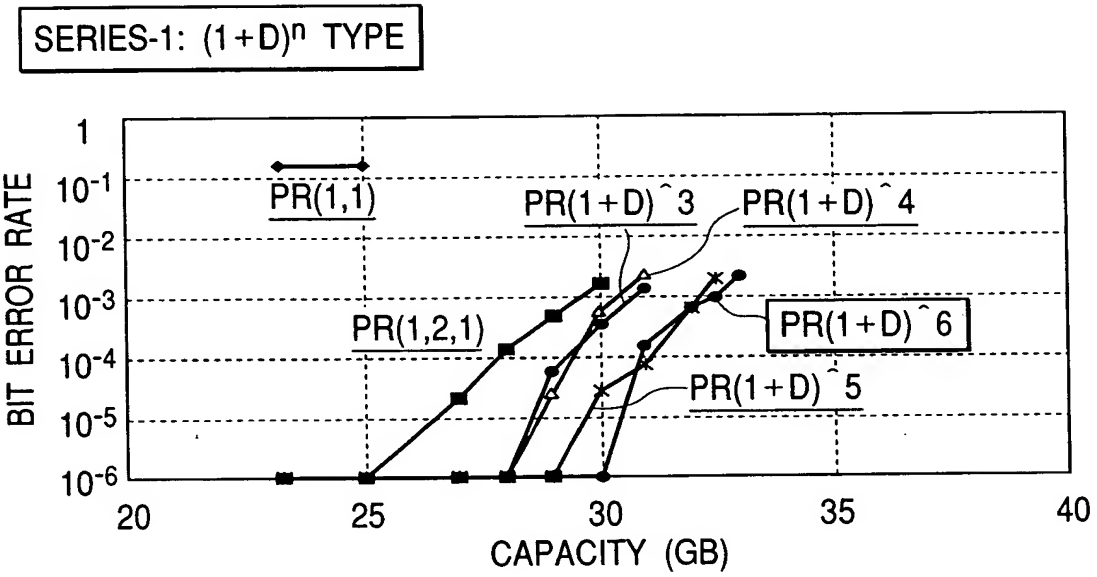


FIG. 2B

CLASS-BIT	CLASS EXPRESSION	BIT-ARRAY	NUMBER OF STATUS	NUMBER OF LEVELS	CAPACITY (GB)
2	(1,1)	4	2	3	<<23
3	(1,2,1)	6	4	4	<28
4	(1,3,3,1)	10	6	7	<29
5	$(1+D)^4$	16	10	10	<29
6	$(1+D)^5$	26	16	15	<31
7	$(1+D)^6$	42	26	22	<31

FIG. 3A

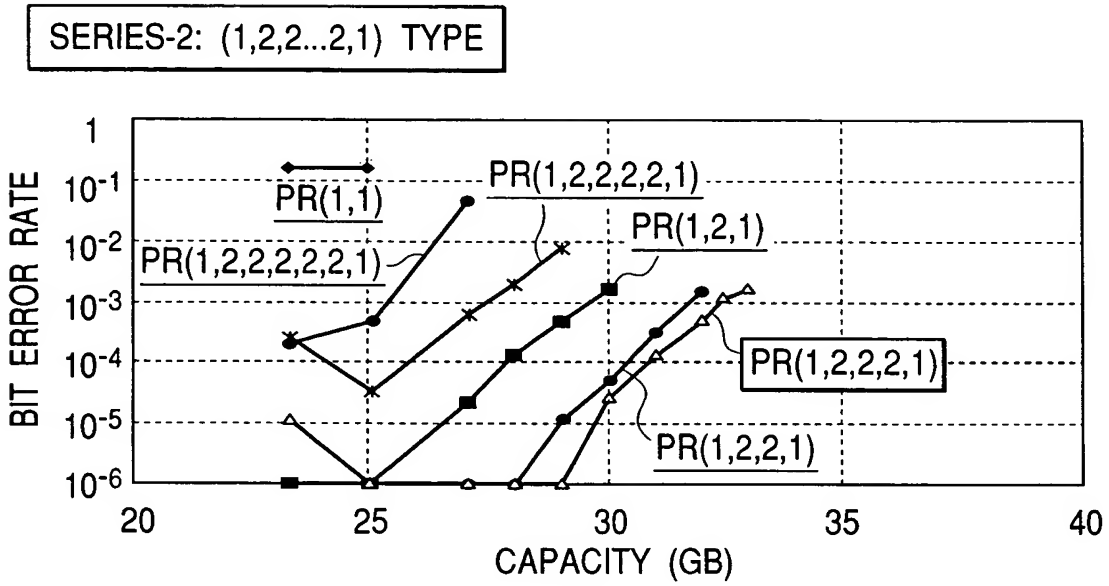


FIG. 3B

CLASS-BIT	CLASS EXPRESSION	BIT-ARRAY	NUMBER OF STATUS	NUMBER OF LEVELS	CAPACITY (GB)
2	(1,1)	4	2	3	<<23
3	(1,2,1)	6	4	4	<28
4	(1,2,2,1)	10	6	7	<30
5	(1,2,2,2,1)	16	10	9	<31
6	(1,2,2,2,2,1)	26	16	11	<25
7	(1,2,2,2,2,2,1)	42	26	13	<23

FIG. 4A

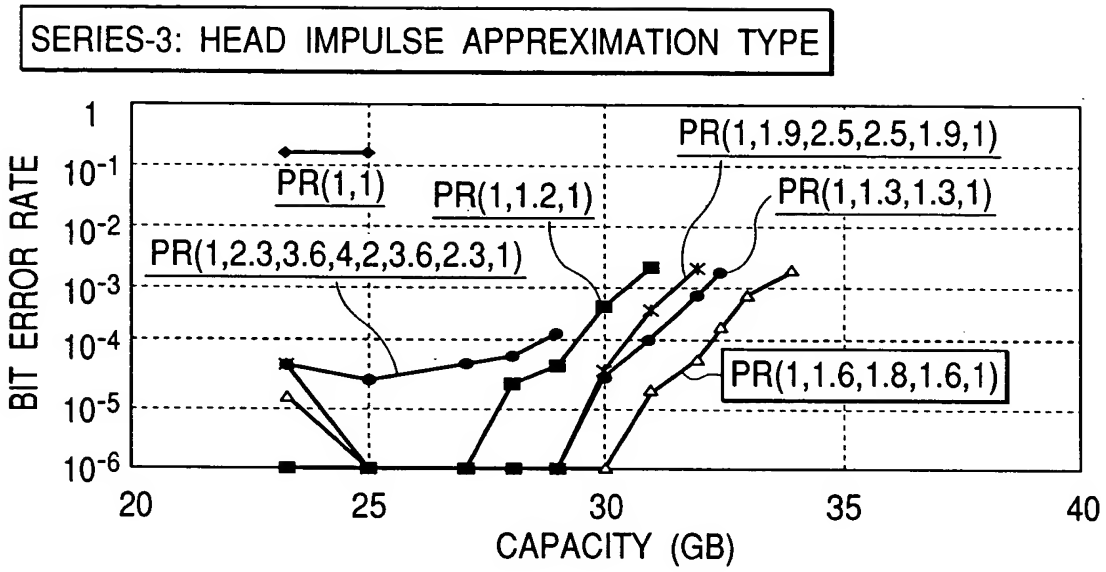


FIG. 4B

CLASS-BIT	CLASS EXPRESSION	BIT-ARRAY	NUMBER OF STATUS	NUMBER OF LEVELS	CAPACITY (GB)
2	(1,1)	4	3	3	<<23
3	(1,1.2,1)	6	4	4	<28
4	(1,1.3,1.3,1)	10	6	7	<31
5	(1,1.6,1.8,1.6,1)	16	10	10	<32
6	(1,1.9,2.5,···)	26	16	15	<30
7	(1,2.3,3.6,···)	42	26	22	<27

FIG. 5A

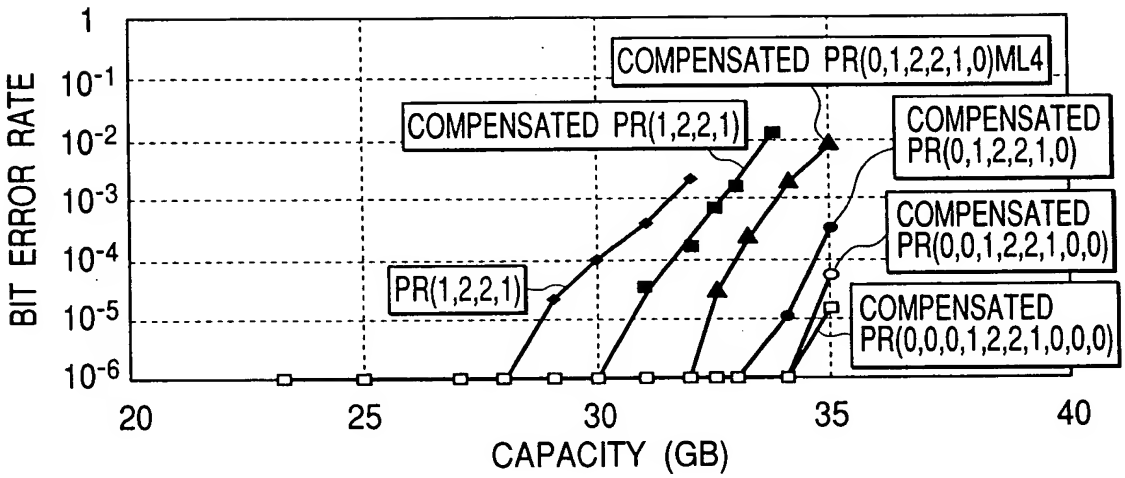


FIG. 5B

CLASS EXPRESSION	NUMBER OF BIT-ARRAY	NUMBER OF STATUS	NUMBER OF LEVELS	COMPENSATION BITS	ML BIT
PR(1,2,2,1)	10	6	7	0	4
COMPENSATED PR(1,2,2,1)	10	6	10	4	4
COMPENSATED PR(0,1,2,2,1,0)ML4	26	6	26	6	4
COMPENSATED PR(0,1,2,2,1,0)	26	16	26	6	6
COMPENSATED PR(0,0,1,2,2,1,0,0)	68	42	68	8	8
COMPENSATED PR(0,0,0,1,2,2,1,0,0,0)	178	110	178	10	10

FIG. 6A

RLL(1,7)
PR(1,2,2,1)
MARK = LOW LEVEL

NO.	BIT ARRAY	TARGET LEVEL	RLL ERROR
0	0 0 0 0	1.00	
1	0 0 0 1	0.67	
2	0 0 1 0	0.33	×
3	0 0 1 1	0.00	
4	0 1 0 0	0.33	×
5	0 1 0 1	0.00	×
6	0 1 1 0	−0.33	
7	0 1 1 1	−0.67	
8	1 0 0 0	0.67	
9	1 0 0 1	0.33	
10	1 0 1 0	0.00	×
11	1 0 1 1	−0.33	×
12	1 1 0 0	0.00	
13	1 1 0 1	−0.33	×
14	1 1 1 0	−0.67	
15	1 1 1 1	−1.00	

FIG. 6B

BIT ARRAY NUM = 10
STATE NUM = 6
TARGET LEVEL NUM = 7

NO.	BIT ARRAY	TARGET LEVEL
0	0 0 0 0	1.00
1	0 0 0 1	0.67
2	0 0 1 1	0.00
3	0 1 1 0	−0.33
4	0 1 1 1	−0.67
5	1 0 0 0	0.67
6	1 0 0 1	0.33
7	1 1 0 0	0.00
8	1 1 1 0	−0.67
9	1 1 1 1	−1.00

FIG. 7A

RLL(2,10)
PR(3,4,4,3)
MARK = LOW LEVEL

NO.	BIT ARRAY	TARGET LEVEL	RLL ERROR
0	0 0 0 0	1.00	
1	0 0 0 1	0.57	
2	0 0 1 0	0.43	×
3	0 0 1 1	0.00	
4	0 1 0 0	0.43	×
5	0 1 0 1	0.00	×
6	0 1 1 0	−0.14	×
7	0 1 1 1	−0.57	
8	1 0 0 0	0.57	
9	1 0 0 1	0.14	×
10	1 0 1 0	0.00	×
11	1 0 1 1	−0.43	×
12	1 1 0 0	0.00	
13	1 1 0 1	−0.43	×
14	1 1 1 0	−0.57	
15	1 1 1 1	−1.00	

FIG. 7B

BIT ARRAY NUM = 8
STATE NUM = 6
TARGET LEVEL NUM = 5

NO.	BIT ARRAY	TARGET LEVEL
0	0 0 0 0	1.00
1	0 0 0 1	0.57
2	0 0 1 1	0.00
3	0 1 1 1	−0.57
4	1 0 0 0	0.57
5	1 1 0 0	0.00
6	1 1 1 0	−0.57
7	1 1 1 1	−1.00

FIG. 8

RLL(1,7)
COMPENSATED PR(1,2,2,1)
MARK = LOW LEVEL

NO.	BIT ARRAY	RLL(1,7) PR(1,2,2,1)	RLL(2,10) PR(3,4,4,3)		
		INITIAL TARGET	INITIAL TARGET	RLL ERROR	RLL COMPENSATION VALUE
0	0 0 0 0	1.000	1.000		0.000
1	0 0 0 1	0.667	0.571		−0.095
2	0 0 1 1	0.000	0.000		0.000
3	0 1 1 0	−0.333	−0.143	×	∞
4	0 1 1 1	−0.667	−0.571		0.095
5	1 0 0 0	0.667	0.571		−0.095
6	1 0 0 1	0.333	0.143	×	∞
7	1 1 0 0	0.000	0.000		0.000
8	1 1 1 0	−0.667	−0.571		0.095
9	1 1 1 1	−1.000	−1.000		0.000

FIG. 9

RLL(1,7)
COMPENSATED PR(1,2,2,1)
MARK = LOW LEVEL

NO.	BIT ARRAY	INITIAL TARGETS	COMPENSATION VALUE	COMPENSATION TARGET
0	0 0 0 0	1.000	0.180	1.18
1	0 0 0 1	0.667	−0.145	0.52
2	0 0 1 1	0.000	−0.051	−0.05
3	0 1 1 0	−0.333	0.276	−0.06
4	0 1 1 1	−0.667	0.094	−0.57
5	1 0 0 0	0.667	−0.145	0.52
6	1 0 0 1	0.333	−0.372	−0.04
7	1 1 0 0	0.000	−0.050	−0.05
8	1 1 1 0	−0.667	0.076	−0.59
9	1 1 1 1	−1.000	0.090	−0.91

FIG. 10

RLL(1,7)
COMPENSATED PR(0,1,2,2,1,0)
MARK = LOW LEVEL

NO.	BIT ARRAY			INITIAL TARGET PR(1,2,2,1)	COMPENSATION VALUES (6 BITS)	COMPENSATED TARGETS
	COMPENSATION BIT	PR(1,2,2,1)	COMPENSATION BIT			
0	0	0 0 0 0	0	1.00	0.494	1.494
1	0	0 0 0 0	1	1.00	0.203	1.203
2	0	0 0 0 1	1	0.67	−0.026	0.641
3	0	0 0 1 1	0	0.00	0.129	0.129
4	0	0 0 1 1	1	0.00	−0.056	−0.056
5	0	0 1 1 0	0	−0.33	0.276	−0.057
6	0	0 1 1 1	0	−0.67	0.128	−0.539
7	0	0 1 1 1	1	−0.67	0.077	−0.590
8	0	1 1 0 0	0	0.00	0.133	0.133
9	0	1 1 0 0	1	0.00	−0.019	−0.019
10	0	1 1 1 0	0	−0.67	0.137	−0.530
11	0	1 1 1 1	0	−1.00	0.121	−0.879
12	0	1 1 1 1	1	−1.00	0.118	−0.882
13	1	0 0 0 0	0	1.00	0.494	1.494
14	1	0 0 0 0	1	1.00	0.203	1.203
15	1	0 0 0 1	1	0.67	−0.026	0.641
16	1	0 0 1 1	0	0.00	0.129	0.129
17	1	0 0 1 1	1	0.00	−0.056	−0.056
18	1	1 0 0 0	0	0.67	−0.145	0.522
19	1	1 0 0 0	1	0.67	−0.145	0.522
20	1	1 0 0 1	1	0.33	−0.372	−0.039
21	1	1 1 0 0	0	0.00	0.133	0.133
22	1	1 1 0 0	1	0.00	−0.019	−0.019
23	1	1 1 1 0	0	−0.67	0.137	−0.530
24	1	1 1 1 1	0	−1.00	0.121	−0.879
25	1	1 1 1 1	1	−1.00	0.118	−0.882

FIG. 11

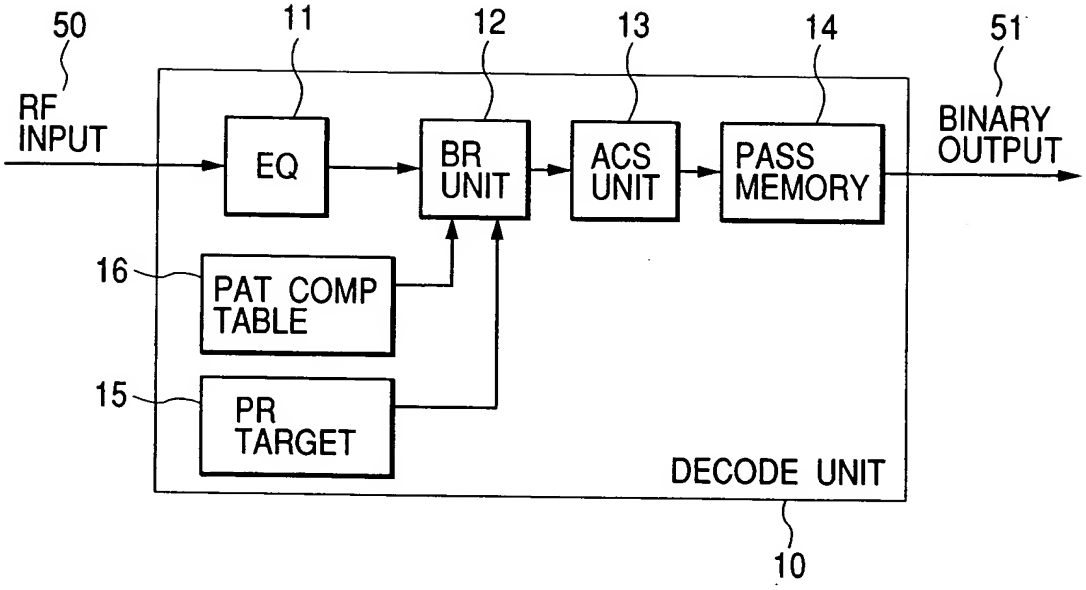

50
RF
INPUT
11
EQ
12
BR
UNIT
13
ACS
UNIT
14
PASS
MEMORY
51
BINARY
OUTPUT
16
PAT COMP
TABLE
15
PR
TARGET
DECODE UNIT
10

FIG. 12

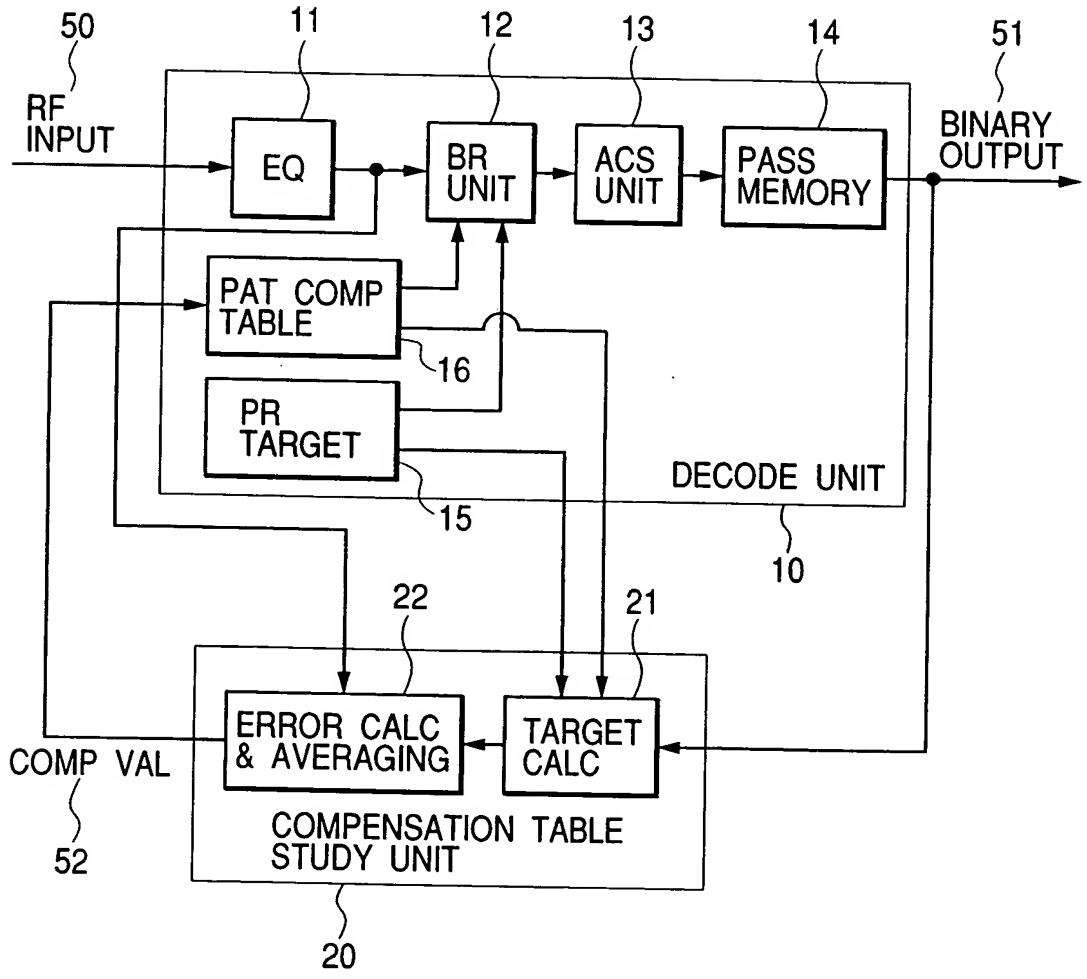

50
11
12
13
14
51
RF INPUT
EQ
BR UNIT
ACS UNIT
PASS MEMORY
BINARY OUTPUT
PAT COMP TABLE
16
PR TARGET
15
DECODE UNIT
10
22
21
ERROR CALC & AVERAGING
TARGET CALC
COMP VAL
52
COMPENSATION TABLE STUDY UNIT
20

FIG. 13

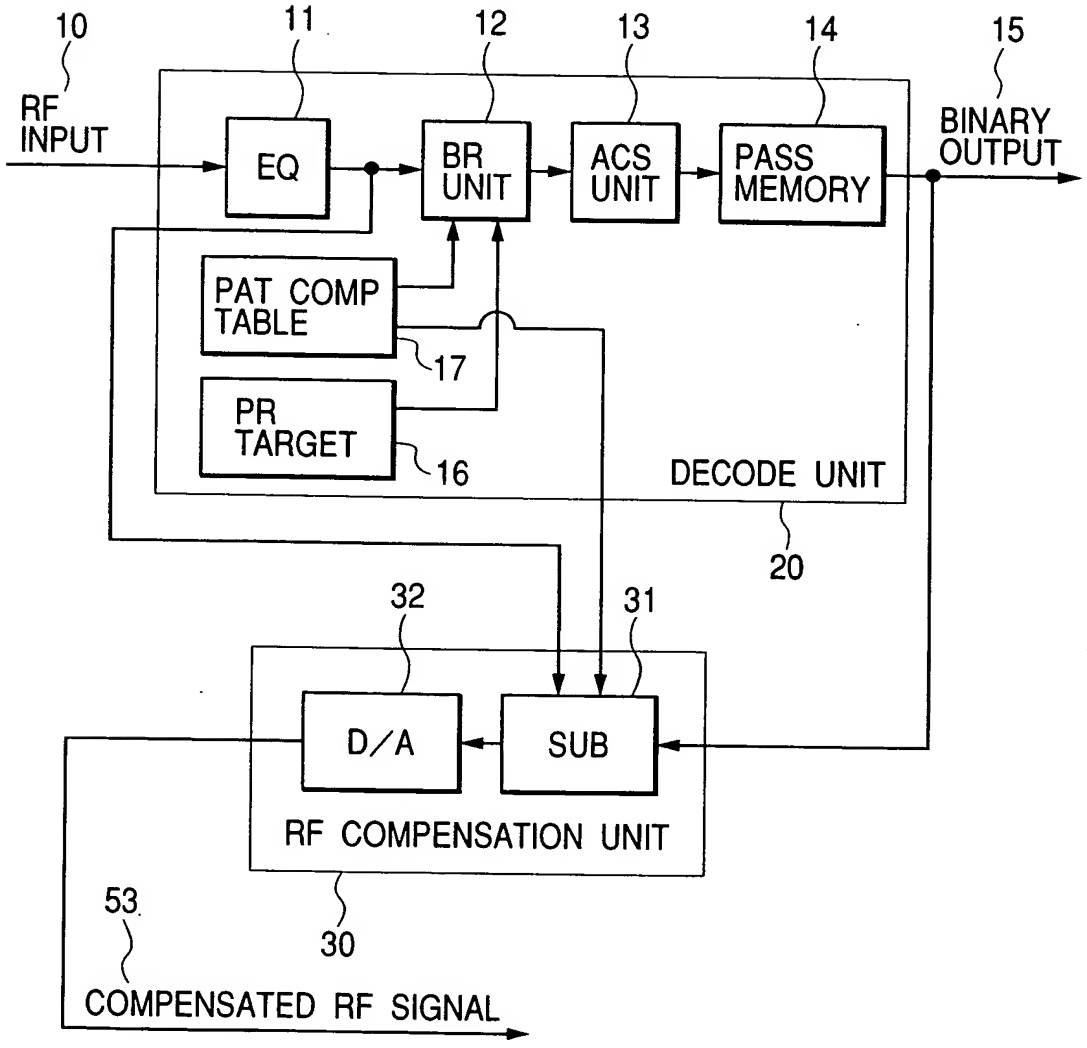

10
11
12
13
14
15
RF INPUT
EQ
BR UNIT
ACS UNIT
PASS MEMORY
BINARY OUTPUT
PAT COMP TABLE
17
PR TARGET
16
DECODE UNIT
20
32
31
D/A
SUB
RF COMPENSATION UNIT
53
30
COMPENSATED RF SIGNAL

FIG. 14

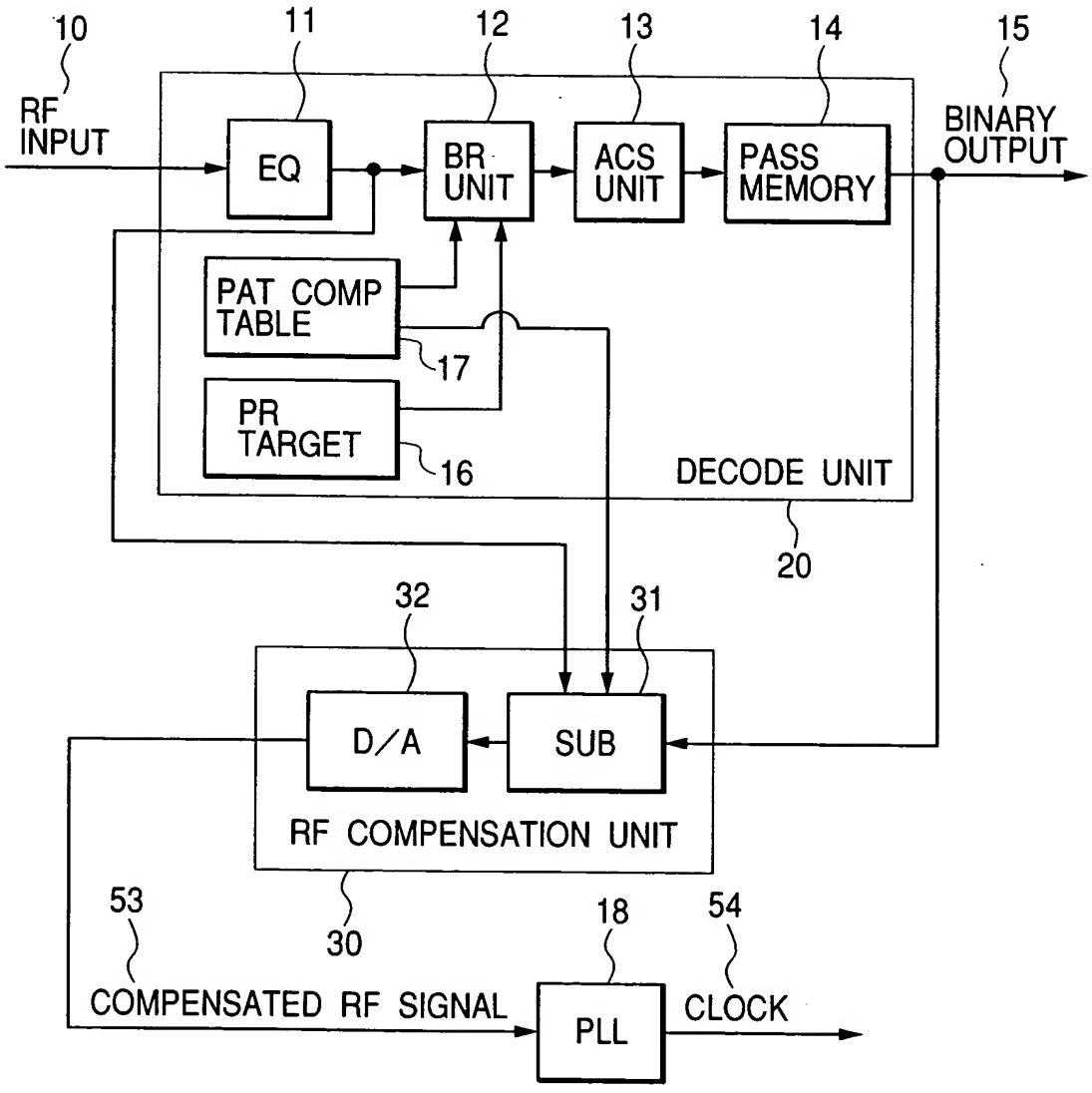

10
11
12
13
14
15
RF INPUT
EQ
BR UNIT
ACS UNIT
PASS MEMORY
BINARY OUTPUT
PAT COMP TABLE
17
PR TARGET
16
DECODE UNIT
20
32
31
D/A
SUB
RF COMPENSATION UNIT
53
30
18
54
COMPENSATED RF SIGNAL
PLL
CLOCK

FIG. 15

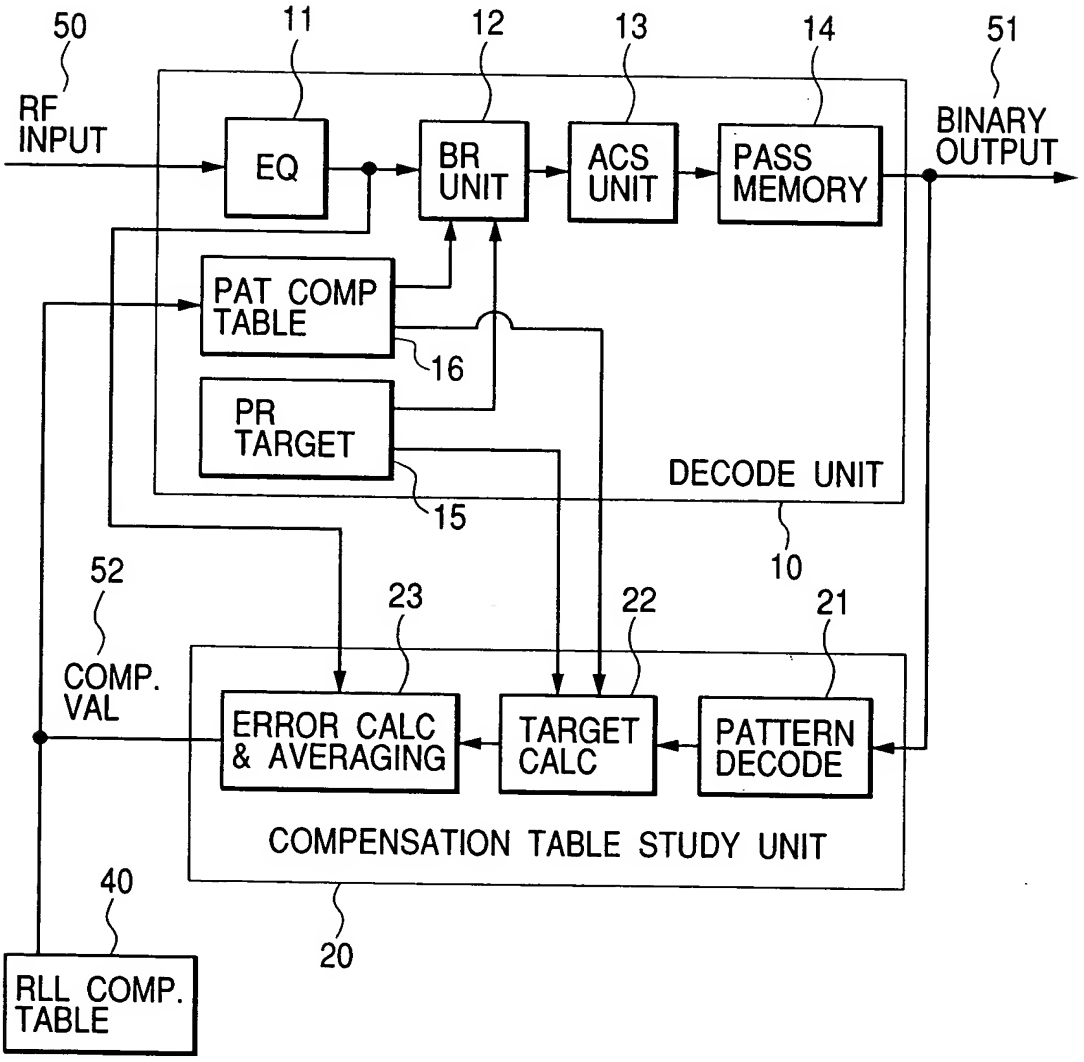

50
11
12
13
14
51
RF INPUT
EQ
BR UNIT
ACS UNIT
PASS MEMORY
BINARY OUTPUT
PAT COMP TABLE
16
PR TARGET
15
DECODE UNIT
10
52
23
22
21
COMP. VAL
ERROR CALC & AVERAGING
TARGET CALC
PATTERN DECODE
COMPENSATION TABLE STUDY UNIT
40
20
RLL COMP. TABLE

FIG. 16

RLL(1,7)
COMPENSATED PR(0,1,2,2,1,0)
MARK = LOW LEVEL

NO.	BIT ARRAY	RLL(1,7) COMPENSATED PR(0,1,2,2,1,0)		RLL(2,10) PR(3,4,4,3)		
		INITIAL TARGETS	COMPEN-SATION VALUES	INITIAL TARGETS	RLL ERROR	RLL COMPEN-SATION
0	0 0 0 0 0 0	1.000	a	1.000		0.000
1	0 0 0 0 0 1	1.000	b	1.000		0.000
2	0 0 0 0 1 1	0.667	c	0.571		0.095
3	0 0 0 1 1 0	0.000	d	0.000	×	∞
4	0 0 0 1 1 1	0.000	e	0.000		0.000
5	0 0 1 1 0 0	−0.333	f	−0.143	×	∞
6	0 0 1 1 1 0	−0.667	g	−0.571		−0.095
7	0 0 1 1 1 1	−0.667	h	−0.571		−0.095
8	0 1 1 0 0 0	0.000	i	0.000	×	∞
9	0 1 1 0 0 1	0.000	j	0.000	×	∞
10	0 1 1 1 0 0	−0.667	k	−0.571		−0.095
11	0 1 1 1 1 0	−1.000	l	−1.000		0.000
12	0 1 1 1 1 1	−1.000	m	−1.000		0.000
13	1 0 0 0 0 0	1.000	n	1.000		0.000
14	1 0 0 0 0 1	1.000	o	1.000		0.000
15	1 0 0 0 1 1	0.667	p	0.571		0.095
16	1 0 0 1 1 0	0.000	q	0.000	×	∞
17	1 0 0 1 1 1	0.000	r	0.000	×	∞
18	1 1 0 0 0 0	0.667	s	0.571		0.095
19	1 1 0 0 0 1	0.667	t	0.571		0.095
20	1 1 0 0 1 1	0.333	u	0.143	×	∞
21	1 1 1 0 0 0	0.000	v	0.000		0.000
22	1 1 1 0 0 1	0.000	w	0.000	×	∞
23	1 1 1 1 0 0	−0.667	x	−0.571		−0.095
24	1 1 1 1 1 0	−1.000	y	−1.000		0.000
25	1 1 1 1 1 1	−1.000	z	−1.000		0.000

FIG. 17

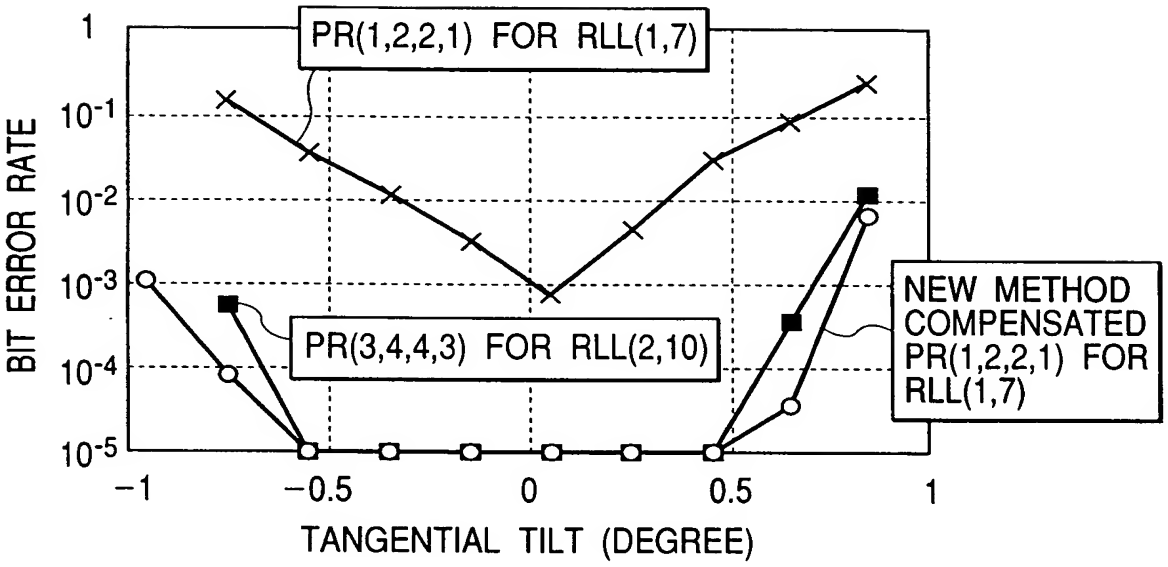
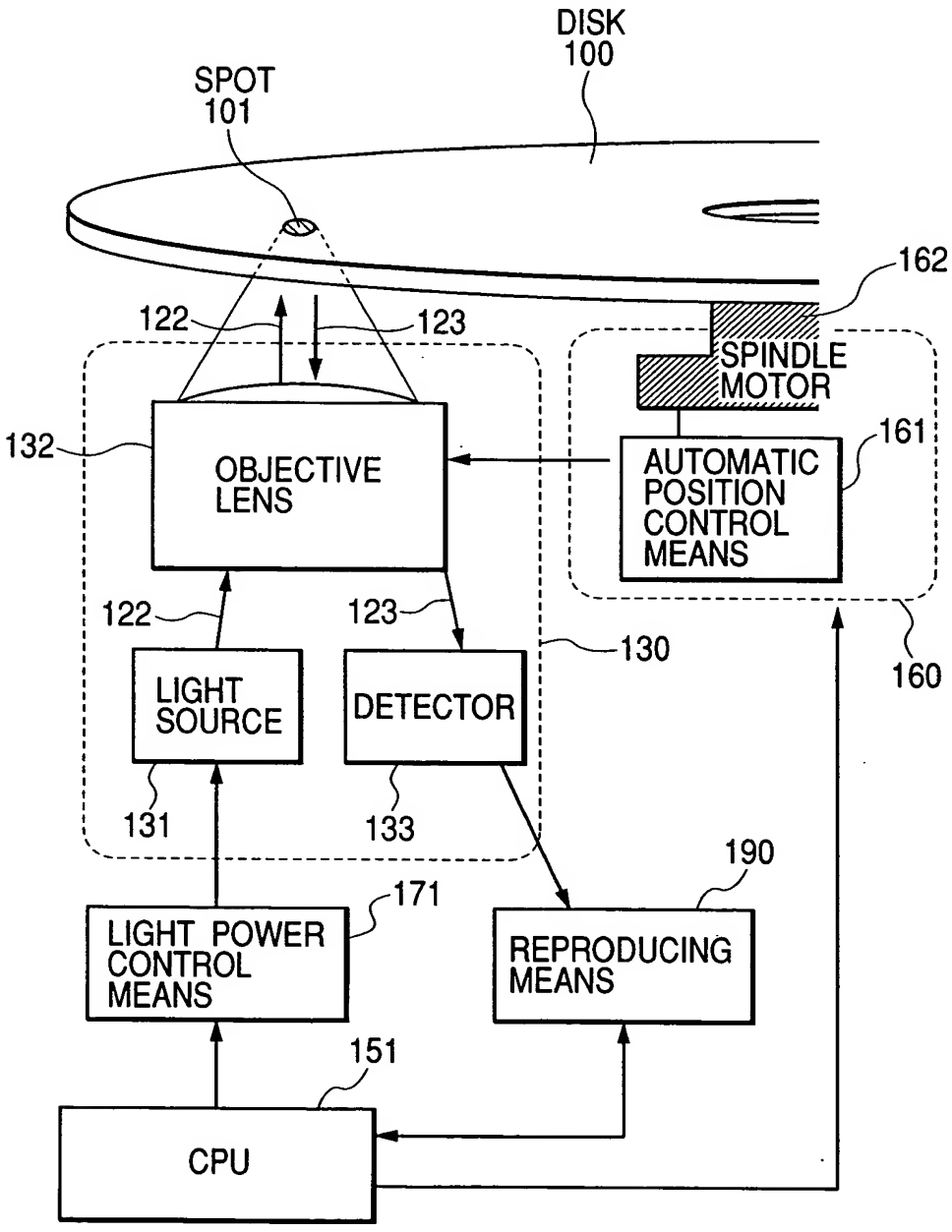

PR(1,2,2,1) FOR RLL(1,7)
PR(3,4,4,3) FOR RLL(2,10)
NEW METHOD COMPENSATED PR(1,2,2,1) FOR RLL(1,7)
BIT ERROR RATE
1
10-1
10-2
10-3
10-4
10-5
−1
−0.5
0
0.5
1
TANGENTIAL TILT (DEGREE)

FIG. 18


DISK
100
SPOT
101
162
122
123
SPINDLE
MOTOR
132
OBJECTIVE
LENS
161
AUTOMATIC
POSITION
CONTROL
MEANS
122
123
130
160
LIGHT
SOURCE
DETECTOR
131
133
190
171
LIGHT POWER
CONTROL
MEANS
REPRODUCING
MEANS
151
CPU